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Effects of Very Low Birth Weights on Fetal and Neonatal Mortality Rates in Alabama

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Synopsis

The relationship of births weighing less than 1,000 grams (g) to fetal and neonatal mortality

rates, including changes over time, was studied. In Alabama during the period 1974-84, the percentage of reported births that weighed less than 500 g doubled, and the percentage of reported births weighing 500 to 999 g increased by about 10 percent.

By the end of the study, while only 0.13 percent of reported births weighed less than 500 g, 24 percent of all stillbirths and 14 percent of all neonatal deaths were in this birth weight group. Similarly, in 1984, while only 0.62 percent of all births weighed 500 to 999 g, 23 percent of stillbirths and 42 percent of neonatal deaths were in this birth weight group.

The data suggest that Alabama neonatal and fetal mortality rates declined more than was apparent in vital statistics data because of changes in reporting practices for very low birth weight newborns during the study period. Changes in vital statistics reporting are suggested to improve data reliability.

EXTENSIVE STUDY of infant, neonatal, and perinatal mortality rates has shown a close relationship between low birth weight and fetal and neonatal mortality (1-3) and a need to evaluate mortality by birth weight grouping (4-7). However, the influence of pre-viable births, as well as births of borderline viability, on stillbirth and neonatal mortality rates, has not been well studied.

Factors which limit understanding of the influence of very low weight births on vital statistic measurements include (a) variations in legal definitions of live birth and stillbirth among geographic areas; (b) variations in reporting, even within areas using standard definitions; (c) a tendency to report separately data about neonatal mortality and stillbirth; and (d) a tendency evident in most vital

statistics data not to define the lower limits of the lowest birth weight group (8,9).

During a continuing study of pregnancy outcome in Alabama, pre-viable births and births of infants of borderline viability were seen as making an increasing contribution to both stillbirth and neonatal mortality rates (10). However, because of the factors noted, we had little information about how the relationship was changing. Neither did we understand how changes in the numbers of very low birth weight live births, stillbirth and neonatal deaths were related.

Methods

Data were obtained from birth and death certificates which are returned to the Department of Vital Statistics of the Alabama Department of Public Health. Computerized data on live births, fetal deaths, and neonatal deaths were obtained on magnetic tape for the years 1974, 1976, 1977, and 1979 through 1984 (data for 1975 and 1978 were not available on tape). Altogether, 546,239 live births, 6,466 stillbirths, and 4,825 neonatal deaths were analyzed.

Fetal death is defined by State law as stillbirth of gestational age 20 weeks or older. Therefore some stillbirths (with or without congenital anomalies) are included that were reported as secondary to induced abortion. However, the percentage of fetal deaths secondary to induced abortion was less than 5 percent in any one year and did not change significantly during the period studied. Live birth is defined as showing signs of life, such as heartbeat or respiration. A neonatal death is any death of a liveborn infant in the first 27 days of life.

In Alabama, as in most States, gestational age is not part of the definition of live birth, and birth weight is not part of the definition of either live birth or stillbirth (8). Thus, the lower limits of birth weight and gestational age for live births and stillbirth differ in the available State vital statistics data sets. This anomaly makes the birth weight-specific neonatal and fetal mortality data for the group weighing less than 500 grams (g) at birth not comparable to each other, and possibly to other data sets. However, the definitions, and the methods of data collection and analysis used in our study, were consistent from year to year, and the data are those used in all Alabama State vital statistics reports.

Live births and stillbirths recorded as weighing less than 1,500 g were divided into three birth weight groups, less than 500 g, 500-999 g, and

1000-1499 g. In the first set of analyses, the number of live births and stillbirths in each birth weight group for each year were divided by the total number of fetal and live births that year, and the ratio calculated. In the second set of analyses, the number of live births, stillbirths, and neonatal deaths in each birth weight group were divided by the corresponding total of live births, stillbirths, or neonatal deaths which occurred that year. The ratios of birth weight-specific live births to all live births, birth weight-specific stillbirths to all stillbirths, and birth weight-specific neonatal deaths to all neonatal deaths were calculated. Significant changes over time were calculated using an analysis of trend in proportions (11). The procedure provides an estimate of the slope of the regression line and tests its linear component, such as, for example, whether the slope is significantly different from zero. This results in a chi-square distribution with 1 degree of freedom.

Results

Table 1 shows all births, live births, and stillbirths in three very low birth weight groups as percentages of the total number of births in selected years. In the 1,000-1,499 g group, a small but statistically significant decrease of all births as a percentage of total births can be noted. While the percentage of live births did not change significantly in that weight group, there was a significant decrease in the percentage of stillbirths.

There was about a 10 percent increase in all births in the 500-999 g birth weight group, as a percentage of total births, during the study period. The increase resulted in part from a large increase in the percentage of live births in this weight group, and a decrease in the percentage of stillbirths.

Live births and stillbirths in the less than 500 g weight group, expressed as a percentage of all births, nearly doubled during the study period.

Table 2 shows the contribution by year of each low birth weight group to live births, stillbirths, and all neonatal deaths. In the 1,000-1,499 g birth weight group, neither the percentage of live births, nor its relative contribution to stillbirths, changed during the period. However, the contribution of this birth weight group to neonatal mortality fell by more than half because of the decline in neonatal deaths.

As noted, there was a very small, but statistically significant, increase in the yearly percentages of live births in the 500-999 g group. However, more

Table 1. All births, live births, and stillbirths, in three very low birth weight groups, as percentages of the total number of births, by selected years, in Alabama

Year	Total births	Percent less than 500 g			Percent 500-999 g			Percent 1,000-1,499 g		
		All ¹ births	Live ¹ births	Still ¹ births	All ² births	Live births	Still ¹ births	All ³ births	Live ⁴ births	Still ⁵ births
1974	60,228	0.20	0.04	0.16	0.72	0.41	0.31	0.94	0.77	0.16
1976	58,693	0.23	0.09	0.13	0.82	0.51	0.39	0.89	0.76	0.14
1977	62,707	0.21	0.06	0.15	0.72	0.42	0.31	0.80	0.68	0.12
1979	63,143	0.31	0.10	0.21	0.71	0.47	0.24	0.88	0.76	0.13
1980	64,128	0.33	0.09	0.23	0.81	0.55	0.27	0.77	0.63	0.14
1981	62,251	0.31	0.08	0.23	0.78	0.47	0.30	0.84	0.72	0.12
1982	60,971	0.39	0.11	0.28	0.85	0.60	0.25	0.83	0.70	0.13
1983	59,715	0.34	0.09	0.24	0.84	0.60	0.24	0.88	0.76	0.12
1984	60,964	0.37	0.13	0.24	0.85	0.62	0.23	0.76	0.66	0.11

¹ P < 0.001. ² P = 0.001. ³ P = 0.005. ⁴ Not statistically significant. ⁵ P = 0.003.

Table 2. Live births, stillbirths, and neonatal deaths in three very low birth weight groups, in total numbers and as percentages of the total number of live births, stillbirths, and neonatal deaths, by selected years, in Alabama

Year	Total			Percent less than 500 g			Percent 500-999 g			Percent 1,000-1,499 g		
	Live births	Still births	Neonatal deaths	Live births ¹	Still births ¹	Neonatal deaths ¹	Live births ¹	Still births ²	Neonatal deaths ¹	Live births ²	Still births ²	Neonatal deaths ¹
1974	59,342	886	795	0.04	10.4	3.0	0.41	20.8	26.2	0.77	11.0	22.2
1976	57,895	723	684	0.09	10.2	7.2	0.51	24.9	32.4	0.76	11.1	16.8
1977	61,927	780	577	0.06	11.9	5.7	0.42	24.2	29.6	0.68	10.3	17.3
1979	62,484	659	495	0.10	18.5	10.8	0.47	23.2	30.6	0.76	12.0	12.6
1980	63,405	723	506	0.09	20.6	10.4	0.55	23.5	32.4	0.63	12.7	7.3
1981	61,497	754	456	0.07	18.7	9.5	0.47	24.5	35.9	0.72	10.2	11.7
1982	60,296	675	476	0.11	24.7	12.3	0.60	22.7	38.1	0.70	11.9	10.5
1983	59,057	658	408	0.09	21.7	11.1	0.60	21.4	37.8	0.76	10.8	9.0
1984	60,336	608	428	0.13	23.6	13.7	0.62	22.9	41.5	0.66	10.5	8.9
Total	546,239	6,466	4,825

¹ P < 0.001. ² Not statistically significant.

than 20 percent of all stillbirths were found consistently in this birth weight group, with no significant change during the period. The percent of all neonatal deaths in this birth weight group increased from 26 to nearly 42 percent.

The less than 500 g birth weight group contributed an increasing percentage of all live births, stillbirths, and neonatal deaths during the period. Although the percentage of live births reported for the group doubled, the contribution of the group to total births remains minuscule (about one-tenth of a percent). However, the percentage of all stillbirths in the group increased from 10 to nearly 24 percent. Similarly, the percentage of all neonatal deaths in the group increased nearly fourfold in the period, and now contributes nearly 14 percent of all neonatal deaths.

Table 3 shows stillbirths as yearly percentages of total births in the three birth weight groups. The percentages of stillbirths were higher for lower

birth weight groups. In recent years, about 70 percent of the less than 500 g births were recorded as stillbirths, compared with about 14 percent of the 1,000 to 1,499 g births. For both the 500-999 and 1,000-1,499 g groups, there was a statistically significant decrease in the percentage of births recorded as stillbirths. There was no statistically significant change during the study period in the percentage of less than 500 g births recorded as stillbirths.

Discussion

The study demonstrates the changing contribution of very low birth weight births to various types of vital statistics data, and suggests several reasons for the changes.

First, while there has been a small but statistically significant decrease in the percentage of total births in the 1,000-1,499 g group, there were

increased percentages of births reported in the two groups weighing less than 1,000 g. From our data, it is not possible to determine if the increases in the percent of births weighing less than 1,000 g are real, or if they result from changes in reporting. However, previous documentation of under-reporting of births and deaths in those weight groups (12,13), and our observations of changes in reporting practices related to less than 1,000 g birth weights, suggest that increased reporting is the factor most likely to explain the increase in reported births in the two weight groups. The fact that there has been little change in the percentage of births in the 1,000–1,499 g group, a very low birth weight group not as likely to be under-reported as higher weight groups, suggests that the increase in the total number of births in the lower birth weight groups was from an increase in reporting. There was no significant change in the number of births in the 1,500 to 2,499 g weight group.

The relationship between live births, stillbirths, and neonatal deaths was different in each of the birth weight groups. In the 1,000–1,499 g group, the percentage of stillbirths was relatively small and decreased slightly with time. The contribution of this group to total neonatal deaths decreased more rapidly.

In the 500–999 g group, there was a small decrease in the percentage of stillbirths and a corresponding increase in live births. The increase likely was partly from an increase in reporting and partly from a decrease in stillbirths. Other studies have documented that the neonatal mortality rates have fallen more slowly in this birth weight group than in the other low birth weight groups (4,5). The fact that there were more live births and a smaller decrease in the neonatal mortality rates in this group than in the heavier birth weight groups led to a greater percentage of the total neonatal deaths in this birth weight group over time.

There was an almost certain increase in reporting of the less than 500 g births. Since virtually all live births in this birth weight group will result in neonatal death, any increase in reported live births in this birth weight group will contribute substantially to an increase in the vital statistics neonatal mortality rates. In fact, this appears to have occurred, because by the end of the study period, 14 percent of all neonatal deaths reported were in the less than 500 g birth weight group. The increase in the number of reported stillbirths in the group, combined with decreases in stillbirth in heavier birth weight groups, led to an increase in the

Table 3. Stillbirths as percentages of total births in three very low birth weight groups, by selected years, in Alabama

Year	Less than 500 g ¹	500–999 g ²	1,000–1,499 g ³
1974	75	43	17
1976	56	48	16
1977	71	43	15
1979	68	34	15
1980	70	33	15
1981	74	38	14
1982	72	29	16
1983	71	30	14
1984	65	27	14

¹ Not statistically significant.

² $P < 0.001$.

³ $P < 0.05$.

percent of total stillbirths found in the group during the study period.

The neonatal and fetal death rates could have been expected to have decreased more than was seen in the State vital statistics reports if the increase in reported births in the two lowest birth weight groups had not occurred. The magnitude of this effect cannot be determined. We estimate that the stillbirth rate, which decreased from about 15 to 10 deaths per thousand total births during the period studied, would have decreased to 9 per thousand, if increased reporting in the less than 500 g category had not occurred. Similarly, we estimate that because of increased reporting, the neonatal mortality rates, which fell from about 13 to 8 deaths per thousand live births during the period, would have fallen to about 6 per thousand. Therefore, it is likely that the changes in death rates seen in Alabama vital statistic reports do not reflect the actual reductions in mortality which occurred.

The major changes in reporting practices appear to have occurred in the lowest birth weight group. The reason for the apparent increase in reporting of those births was not studied. However, that weight group is at the edge of viability, and for it the dividing lines between live birth, stillbirth, and spontaneous mid-trimester abortion are obscure and, in individual cases, often difficult to determine. That group is therefore most open to assignment to categories based on physician judgment. Our personal observations in Alabama indicate that factors such as the increasing use of perinatal centers for very low birth weight deliveries, the use of early ultrasound for obstetric dating, and increased pressure from State health authorities for more complete reporting have contributed to increases in registering less than 500 g births. However, we believe these circumstances are not unique

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to Alabama and are occurring throughout the country to some degree. As the gestational age of viability decreases, it is likely that more mid-trimester births and spontaneous abortions of less than 500 g will be reported. As shown in this study, increased reporting should contribute to an apparent rise in the neonatal mortality and still-birth rates.

To avoid confusion, we suggest several changes in vital statistics reporting. Regardless of State law requirements for reporting stillbirths and live births, we suggest that all State reports include birth weight-specific data for live births and stillbirths weighing 500 g and more. This convention, already widely used, will avoid many of the difficulties associated with fuzzy definitions at the lower end of the live birth and stillbirth spectrums. Reporting birth weight-specific birth rates and neonatal and fetal mortality rates for 250 g or 500 g birth weight groups from 500 to 5,000 g would, of course, provide much additional information not routinely available from each State.

Reporting the number of stillbirths and live births in each birth weight group in the same table is important, especially in the lowest birth weight groups. Since stillbirths contribute a substantial portion of the total births in these groups, a reduction in very low birth weight stillbirths is likely to cause a significant increase in the number of live births. An increase in the number of very low birth weight live births, with an associated high mortality rate, will, in turn, increase the number of neonatal deaths in the weight group as well as the overall neonatal mortality rate.

Only when the data are presented together will the effect of one upon the other become clear, and the relationship between changes occurring in the very lowest birth weight group and the total mortality rate be better understood.

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